WOOD

A GEOGRAPHIC INFORMATION SYSTEM

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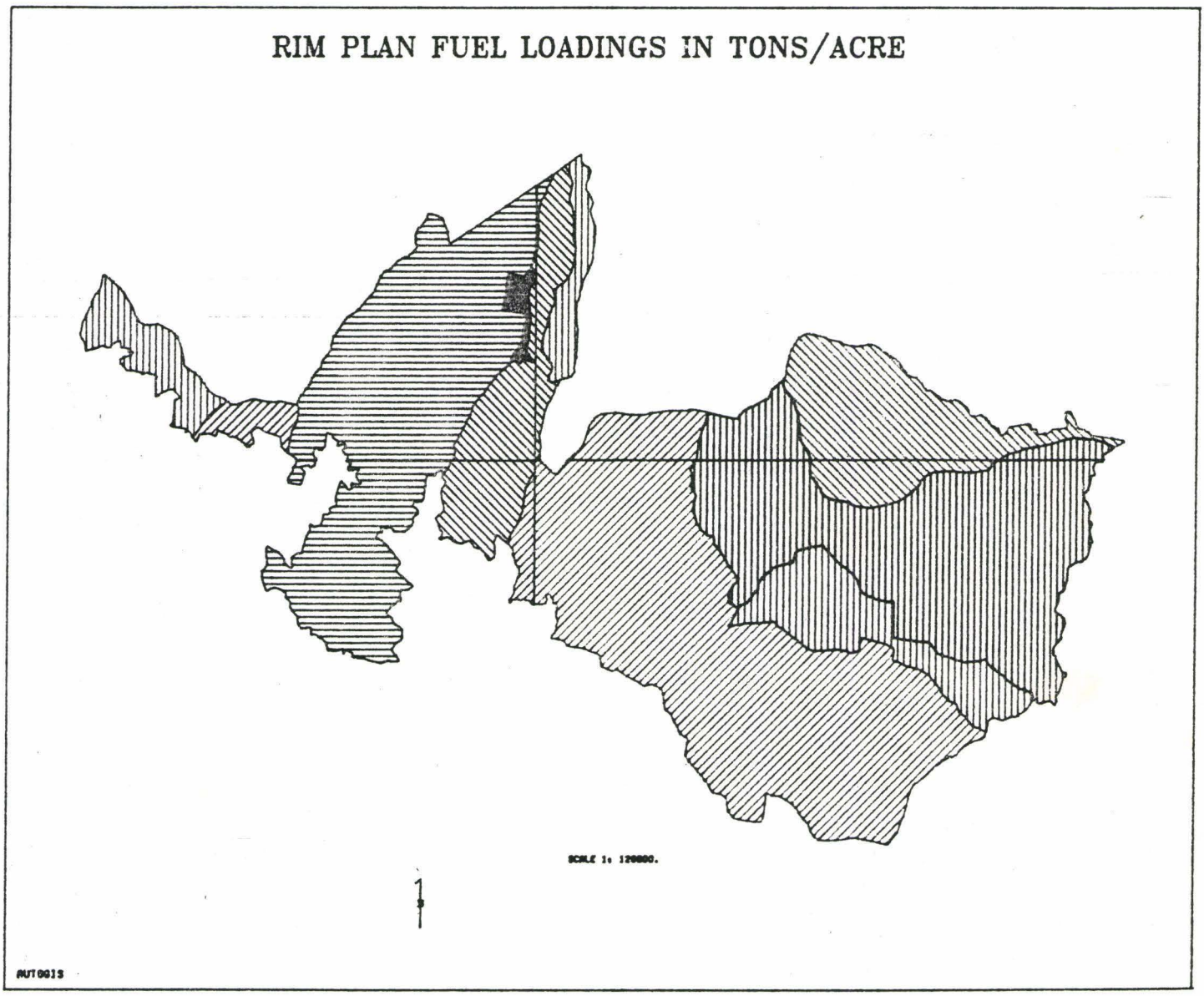
APPLICATION FOR FINDING CAMPING OPPORTUNITIES ON THE APACHE/SITGREAVES



A GEOGRAPHIC INFORMATION SYSTEM APPLICATION FOR FINDING CAMPING OPPORTUNITIES ON THE APACHE/SITGREAVES

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Clemson Class of 1987

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ABSTRACT

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Title: A Geographic Information System Application For Finding Camping Opportunities On The Apache/Sitgreaves

The Rim Lakes Recreation Plan requires the designation of specific dispersed camping sites. At the same time the Forest Land Management Plan provides direction which will influence this designation. The use of GIS has merged this direction to provide a starting point for site designation with little or no conflict between resources. Approximately 2,000 acres out of 11,000 are being recommended for dispersed camping designation. An additional 4,500 acres are recommended for conflict resolution so that it will be available for site designation. A recreation opportunity spectrum classification change on one small area is also indicated.

EXECUTIVE SUMMARY

Title: A Geographic Information System Application For Finding Camping Opportunities on the Apache/Sitgreaves

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Summary: The Apache - Sitgreaves National Forests have completed a recreation plan for an area along the Mogollon Rim on the Chevelon and Heber Ranger Districts. This plan calls for the designation of specific dispersed camping sites. This project is intended to integrate Land Management Plan direction so that site designation can begin in areas with the least amount of resource conflict.

Various map layers were created to accomplish the project. These layers included maps for soils, fuels, user zones, recreation opportunity spectrum

classes, roads and sensitive wildlife habitats. Creation of the layers required gathering of field information, and entry of the information into a geographic information system (GIS). The layers were also manipulated by GIS to produce three composite maps.

The GIS composite maps indicated a range of acreage available for dispersed camping of from 1,933 acres to 2,110 acres. These maps also indicated an additional acreage of 4,517 acres that could be available if the conflict between fuels and dispersed camping could be resolved. A possible miss classification of 177 acres of key dispersed camping was also indicated along the Rim in the vicinity of Hole-In-Ground.

I recommend that the 2,110 acres shown on the map in Appendix E be used as the starting acreage for the designation of dispersed camping on the Chevelon District. I also recommend that the 4,517 acres on the map in Appendix F be given as much emphasis as possible to reduce the conflict between fuels and dispersed recreation.

Chapter 1 - Introduction

Dispersed camping is an extremely popular activity along the Mogollon Rim in central Arizona. Many dispersed sites in the vicinity of Wood's Canyon and Bear Canyon Lakes on the Chevelon Ranger District, Sitgreaves National Forest have been overused and resource damage is much in evidence. Loss of vegetation, rutted or compacted and eroded soils, burned and defaced trees and litter are ample evidence that these dispersed recreation sites require more intensive and successful management techniques.

The Mogollon Rim is a major escarpment which cuts diagonally across Arizona and into New Mexico in a northwest to southeast direction. To the north of the Rim elevations are approximately one to three thousand feet higher than south of the Rim. When compared to the Phoenix metropolitan area the Rim may be as much as seven thousand feet higher.

The Rim, being forested and cool, offers one of few opportunities for Phoenix and Tucson area residents to find climatic relief and engage in recreational

activities. A series of Rim Lakes constructed and maintained under a Memorandum of Understanding with the Arizona Game and Fish Department, provide nearly all the water related recreation opportunities.

There are developed or semi-developed recreation facilities at each of the Rim Lakes with the exception of Chevelon Canyon Lake which is managed as a trophy fishery by the Arizona Game and Fish Department and can be reached only by trail. Additional developed facilities have been planned and are presently being either constructed or contracted for construction. However, our current estimates of use show that 70% of the recreation activity along the Rim is of a dispersed nature. Current developed capacity for camping along the Rim on the Chevelon and Heber Districts is 780 PAOT's. This then computes to about 1,820 people/day relying on dispersed opportunities during the normal season extending from Memorial Day to Labor Day. Not many more developed facilities could or perhaps even should be considered. According to Downing and Clark (1978), "Dispersed recreation opportunities appear to occupy a unique place on the outdoor recreation opportunity spectrum, and efforts to harden dispersed sites will reduce the range of choice for these users." The Forest Service emphasis in this area has primarily been to provide developed recreation capacity. This has

always been at the expense of displacing dispersed recreationists.

The Apache - Sitgreaves National Forests, Land and Resource Management Plan, or LMP approved in October of 1987 specifies the following under Standards and Guidelines for the Recreation Operation and Maintenance Program Component: "Initiate dispersed area management plans for all concentrated use areas beginning with the Rim area between Coconino N. F. boundary and Willow Springs Lake to be completed by the end of Fiscal Year 1987." As found in the summary for this LMP; "The Proposed Action provides an increased emphasis for fish and wildlife habitat improvement, and recreation management, both developed and dispersed." This same LMP has numerous prescriptions providing for special treatment of sensitive soils, road densities, road locations, specific wildlife habitats, ROS (Recreation Opportunity Spectrum) classes, protection standards and guidelines, etc.. This list is very comprehensive and leaves the land manager with the perplexing question of; How can all these requirements be fitted together to produce the best results?

In the fall of 1986 and during 1987 the Forest developed a recreation plan for the Rim area. This, as stated, was in compliance with the, at that time "Draft", LMP.

This plan calls for a considerable amount of capital investment to expand developed site capacity. The plan also calls for a number of management constraints to be placed on the Rim area. One of these constraints is that all dispersed camping occur in specifically designated locations.

Objective

If all dispersed sites are to be designated within the Rim area where do you start and how can the various resource needs and considerations be tracked? Would it be possible in some clear fashion to display the various resource factors so that dispersed sites could be placed where they had the least adverse effect on the total area's management? Wouldn't it also then be easier to pick out the areas of conflict and decide if there wasn't some way of eliminating that conflict or deciding which use should take precedent? These questions have become the primary objective of this project.

National Direction

Associate Deputy Chief, Charles R. Hartgraves, by letter on May 2, 1988 transmitted the, "National Geographic Information System Plan," to the field. This plan had been approved by the Chief of the Forest Service on January 19, 1988 and it called for implementing a Service-wide GIS(geographic information system) by 1991.

The primary objective of this Service-wide plan would be to provide easy to use technology which would facilitate the access, use and sharing of information to accomplish the Forest Service mission. There were five principles identified to provide guidance to accomplishing this objective.

1. The GIS must support the information needed by the Agency.
2. GIS data must be understood and shared throughout the Agency and with outside interests.
3. The GIS must be easily accessed by Forest Service managers.
4. This technology must fully use existing computer and communication systems.
5. The GIS must be flexible so as to accommodate new technologies.

The Apache/Sitgreaves Forests have been designated the lead unit in the training and development of a GIS in the Southwestern Region. This Forest is utilizing the MOSS(Map Overlay and Statistical System) software program and several resource data layers have been or are being digitized so that they will be available for use in MOSS. This unit's primary impetus for proceeding with a GIS was to provide a method for documenting and displaying management practices as they relate to accomplishing the Forest LMP. As a result some layers

that have been digitized have been useful in solving the dispersed site question but others have had no value. It has also been necessary to collect field data, primarily road locations, and to digitize additional data layers.

CHAPTER 2 - METHODOLOGY

Forest LMP Direction

The Sitgreaves Forest and specifically the Chevelon and Heber Ranger Districts are having to mesh together a large and complex variety of resource standards and guidelines (S&Gs) in order to implement an LMP that directs an emphasis be placed on wildlife habitat and recreation. The combining of these S&Gs as they affect dispersed camping has begun with the development of the Rim Lakes Recreation Management Plan. One task necessary in identifying the key map layers for this project was to pull from the Forest LMP all S&Gs or other direction that could in someway influence dispersed recreation and specifically dispersed camping (See in Appendix A a listing of issues and concerns, management direction and standards and guidelines which have implications for dispersed camping within this recreation area).

Rim Lakes Recreation Management Plan

This plan is now in the implementation stage with developed facilities under construction. The plan has identified which portions of the planning area will be dedicated to dispersed camping but has not identified specific areas or sites. This

designation will be occurring over the next few years as the need develops. There is also much discussion and planning occurring as to the day to day management of the dispersed use. The plan has allocated 25,000 acres of the Chevelon Ranger District and almost an equal amount of the Heber District to three recreation user zones. One zone surrounds Wood's Canyon and Willow Springs Lakes, this includes the area along the Mogollon Rim between the two lakes and the developed recreation sites adjacent to the lakes. This zone will be day-use only except in the developed campgrounds and will allow motorized travel only on designated routes. The second zone is much larger and lays primarily to the north of the day-use area. Camping sites can be chosen at the user's discretion in this zone but they cannot be accessed by motor vehicle. The third zone appears as three separate areas which lie at the extremes of the larger Rim Lakes planning area. In this zone dispersed camping sites are to be designated and vehicles can travel only on designated routes.

It is with the third zone, of 11,000 acres on the Chevelon District, that this project and paper is primarily concerned. In the recreation plan this zone is being used to provide, primarily, dispersed recreation opportunities. There is a partially developed recreation site at Bear Canyon Lake but otherwise there are no recreation improvements. The zone is highly valued for its wildlife habitat and is

currently undergoing its second timber entry. Portions of the zone have also become popular for dispersed camping.

In view of the standards and guidelines set forth in the LMP and now the implementation of the Rim Lakes Plan the question arises; How do we best manage dispersed camping and still give proper consideration to other resource factors and direction under the LMP? The other resource factors which have been given attention and which are the key resources emphasized in the LMP are: transportation network, this includes roads currently open and roads closed; amount of forest fuels occurring in the various portions of the Rim Lakes area; soil types as they are conducive to camping; key wildlife habitats; and ROS classes. There are some additional factors that may be included in future applications but for which data is not now available or complete. This might include, as examples, diversity of stand structure, old-growth values and specific indicator species requirements.

What is to be accomplish through this project is to assemble all pertinent resource data on soils, roads, ROS classes, key wildlife habitats and forest fuels. Then, as necessary, conduct any supplementary field work and enter these data layers into the Forest GIS and have it assist in establishing priority areas for dispersed camping site designation.

Use of Geographic Information System

The Apache - Sitgreaves Forests are the lead unit in the Southwestern Region in the application of a GIS. The Forest intends that this system will be primarily used as a monitoring tool for the LMP but it is beginning to be used for other resource projects. On the Chevelon District nine different map layers have been entered into the GIS. They are as follows:

Timber Stands
TES (Terrestrial Ecosystems Survey)
Transportation System
Hydrology (Streams and Lakes)
Water Sources
Range Allotment Pasture Fences
Wildlife 10K Units (LMP Diversity Units)
Timber Compartments

Several of these layers have been or are being entered for all of the Apache - Sitgreaves and one or two have been entered for only the Chevelon District.

Currently LIDES (Local Interactive Digitizing and Editing System) is being used on this Forest, as a software program, to accomplish all digitizing and labeling of map/data layers for implementation of the, "Map Overlay and Statistical System (MOSS)," GIS. Vern W. Cimmery in an unpublished

paper, "LIDES - A Map Digitizing and Processing Package," describes the historical development of the LIDES hardware and software in the Forest Service. He brings us up to date with a listing and description of the hardware presently being used on this Forest (See Appendix B).

The Forest use of MOSS is one of several pilot programs across the Forest Service aimed at determining National direction for GIS. MOSS is a Data General compatible program which can be utilized at no or at least low cost to the Forest Service as the program is public domain.

Data Layers

TES was the only map which had been digitized that was of value in determining dispersed camping sites. The other map layers felt to be important, required that data be assembled from planning documents such as fuel treatment plans for existing and planned timber sales or by questioning resource specialists familiar with the Rim area. Additional field work was required for some map layers such as the transportation system and, with the exception of TES, all required digitizing. Also, criteria needed to be established for each layer to determine at what point the information being displayed was critical to the decision of allowing dispersed camping.

The following is a discussion of each of the map layers describing the sources for the information and the criteria that was established;

Soils: There are eight different TES map units occurring within the Rim Lakes Area. These are described in the publication entitled, "Terrestrial Ecosystems Survey of the Apache - Sitgreaves National Forest," which was published by the Southwestern Region in 1986. This publication represents a compilation of field work describing predictions and limitations of soil and vegetation behavior within the various land units. Field work for this survey was accomplished beginning in 1979 and was completed in 1986 and represents the most current information for soils on this forest.

There are no soil types that could be considered well suited for the concentrated activities of those people and vehicles associated with dispersed camping. Roads, other than arterials or collectors, accessing the area are typically unsurfaced or inadequately surfaced. Without surfacing the soils tend to have a low bearing strength when wet or are too shallow to support concentrated use. Four TES units were deemed best suited, of those available, for dispersed camping. They were units numbered 196, 197, 201 and 207. These four were selected for one or more of the following reasons;

- They occurred on 0-15% slopes. These slopes would provide an adequate opportunity for dispersed camping.
- They appeared to be vegetatively productive as indicated by the degree of plant competition (being rated either moderate or severe in the TES). This characteristic would help to alleviate one of the major problems associated with dispersed use, that being the loss of vegetation on heavily used dispersed sites.
- They drained and dried readily and there by regained their bearing strength.

Reasons for non-selection were generally because of too much slope or the unit represented a riparian zone.

Fuels: The Chevelon District has a history of large, intense wildfires. Over the past ten years four fires have exceeded the District's suppression capability and required the use of a Class I or II team. Two others during the same period were very close to needing the same effort. These fires typically occur during the early summer fire season and are almost always man-caused. The amount of forest fuels which have accumulated on the District has been a major factor affecting the ability to control these fires and the severity with which they burn.

The area encompassed by the Rim Lakes Plan includes all or portions of; two timber sales (Rim Woods and Porcupine) which have been completed within the last five years and for which

final fuel treatment has been completed or is nearing completion; four timber sales(Snow, Crest, Promontory and Bear) which are in progress and for which some fuels may only have been piled but not burned; and three timber sales (Deer Lake, Ridge and Knoll) which will be offered within the next four years. While the fuel treatment being accomplished in conjunction with these sales is generally adequate to accommodate dispersed camping much reduction of fuels is left to be done. Activity fuels will be treated in this area for the next six or seven years and even then a backlog of residual fuels may remain.

After examining fuel treatment plans for timber sales and other fuel surveys the area encompassing the Chevelon portion of the Rim Lakes Plan fell into seven fuel loading zones. These zones are as follows and a map of their distribution is in Appendix C.

- 10 to 15 tons/acre
- 15 to 25 tons/acre
- 25 to 35 tons/acre
- 40 tons/ acre
- 40 to 60 tons/acre
- 50 to 60 tons/acre
- 60 to 80 tons/acre

It has been determined by fire specialists on the District that areas with fuel loadings of 40 tons/acre or less could be used for dispersed camping. This situation is by no means

a desirable one as fuels should be reduced to 25 tons/acre or less for the risk to be more acceptable. Generally this is the condition reached following treatment of activity fuels on most timber sale areas. The choice of 40 tons as the break point is a reflection that dispersed use has to be to accommodated somewhere.

Wildlife Habitat Areas: The Chevelon District is one of the best elk habitat areas in the State. Arizona Game and Fish personnel have been very concerned during the development of the recreation plan that wildlife be given adequate consideration.

Several locations within the Rim Lakes area were determined by the Zone Biologist to have especially high habitat values. Their value was tied to being a water source or providing a travel corridor.

Deer Lake, Alder Lake, Carr Lake and Horse Shoe Lake have been recognized because they provide permanent or semi-permanent water sources (Alder Lake is intermittent). They each represent the only water source for one to several miles. Arizona State Law states that you cannot camp within 1/4 mile of a water hole if it means that wildlife are denied access to that water. That probably would be the case with these lakes with the possible exception of Deer Lake. The

map layer for wildlife habitat reflects a 1/4 mile zone around each lake as a wildlife/camping conflict zone.

Transportation System: The commercially forested portion of the district has a very high density of roads. This is true of most of the Sitgreaves and reflects the fact that the plateau topography is very conducive to timber harvest and road construction. Road densities run as high as twelve miles per section but six to eight miles of road is more common over most of the harvested portion of the Rim Lakes area.

The Forest LMP has several references to conflicts involving roads and there is a specific standard and guideline addressing road density. That standard and guideline states that, "permanent road densities should average 3.5 miles/square mile or less," and that, "open road densities after timber sale activities cease should average 2.0 miles/square mile or less."

The majority of dispersed camping that occurs in the Rim Lakes area has been and will continue to be tied to motorized access. As a result of this Clemson project and because the Region has embarked on a intensive "Access Management" program, a considerable amount of field checking was done in October, November and December of 1987. This was done to verify the presence and location of roads. The area of

particular concern was that part of the recreation area that would be left open to motorized access and where camp sites are to be designated. Some of these roads had previously been digitized into GIS. But since that had been done directly from USGS quads the work was questioned and found to be largely inaccurate, at least as it applied to local/terminal roads. Many more miles of road were found to exist. This, in part, was due to roads that had been closed but reopened by use. It is assumed that these roads had been left off quads because of their low standard and because they had been closed.

Since the majority of dispersed camping that occurs in the recreation area is tied to motorized access, the map layer showing the road system was overlayed on the other layers. It did not further define the area of no resource conflict. It does, however, show where specific camp sites could be located. These camp sites would not require new access or the opening of a previously closed road. The use of existing access without improvement, if possible, would appear to be supported by Downing and Clark (1978), when they found that, "dispersed recreationists along forest roads prefer a very low level of development or none at all." It is assumed this would also apply to access roads. These roads would have to be reasonably passable and their use should not present serious conflicts with other resources.

ROS: There are three ROS classes which occur within the recreation area. These are the semi-primitive non-motorized, semi-primitive motorized and roaded natural. It was felt that the composite definition for roaded natural best fit the type of atmosphere that presently exists in many of the dispersed camping areas. There are also many areas where the semi-primitive motorized definition fits. The semi-primitive motorizied sites are remote and require more traveling, they are not as familiar to the general public and so are used by a fewer number of campers.

When the ROS classes were inserted into GIS, the roaded natural class was the only class shown as acceptable. This was because the intensity of use expected in these areas plus the possible need for road improvement will probably not be compatible with the definition of the only other possible class, that being the semi-primitive motorized class. This layer was the last layer added to GIS. While overall this was not very restrictive it did eliminate one area that has been very popular with dispersed recreationists. This was the area along the rim on the road to the Hole-In-Ground borrow pit. For this reason, composite maps were created with ROS included and with it not considered.

Preliminary Agreement

On February 11th various District, Zone and Forest specialists were presented the data and GIS displays. Each

layer was described with regards to: the source of the information; at what point the data became critical to determining dispersed camping sites; and the criteria that was considered in determining the critical point. While additional information or refinements would be used in the future, there was agreement that this would provide a starting point for site designation.

The areas where no conflict occurred between any of the layers are shown in Appendix D. If ROS roaded natural only was retained as a limiting factor only 1933 acres were left as available to dispersed camping with no conflict. If no ROS limitation were imposed then 2110 acres were available. This is compared to the original 11,000 acres available in the dispersed camping zone. This map is shown in Appendix D.

CHAPTER 3 - DISCUSSION AND ANALYSIS

Satisfaction of Objective

The objective for this project was to develop a method of displaying resource information, primarily that important to the Forest LMP, to best answer the question, "where should dispersed camping occur?" This project has provided a good start towards the solution of this objective. The composite map in Appendix E will allow the District to begin on the ground designation of sites. The recreation use that will occur on these sites will not adversely affect sensitive or key resources as emphasized in the LMP. The composite maps cannot be expected to provide more than a start as the data from which they were developed was from a larger survey area than that which will be covered by a single dispersed site and so they may not show isolated locations where conflicts might occur.

The key LMP factors of wildlife, dispersed recreation, slash, roads, soil and water quality have been blended together to identify the best opportunities for dispersed camping. Conflict areas, such as between fuels and recreation, have also been identified. When Alternative C in Appendix F is compared with Alternative B in Appendix F the difference

between C and B are the acres which could be treated to provide additional dispersed recreation opportunities. This area amounts to 4,517 acres. The District should now recognize this as high priority for fuel reduction. Brush disposal plans for timber sales and fuel management dollars need to be used in eliminating this conflict.

The criteria that separates an acceptable resource situation from an unacceptable situation should receive more review in the future. The criteria for this project was determined by a limited amount of specialist input and better criteria would result if other disciplines had an opportunity to participate.

GIS Considerations

GIS was used as a tool for this project because of it's availability on the Forest. There had not been any consideration given to the cost of its use when the project was started. There are, however, some key elements which should be considered when reaching the decision to use GIS. Devine and Field (1986), discuss five elements of cost that are likely to be present in each application of GIS. These five costs are: "purchase price, personnel, digitizing, maintenance and support." When looking at the costs of using GIS for projects such as this one for dispersed sites, not all of the elements are pertinent. Purchasing, maintenance and support would have been elements that were addressed

based on the workload analyses for GIS and the organization's subsequent decision to acquire a GIS.

Digitizing and personnel costs are a different matter and are important factors in applying GIS to individual projects. Devine et al. (1986), state that, "approximately 80 percent of the time spent in a GIS application is in digitizing." While a record was not maintained of time spent on the various tasks for this project, digitizing and the associated editing, represented the greatest single expenditure of time. This would be even more true if some credit were given for the time spent digitizing information already in GIS, from previous applications.

In a series of articles in the September 1986 Journal of Forestry, Consoletti; Fleet; and Schwaller and Dealy each discuss alternatives to the line-trace method of digitizing, which is the type being used on this Forest. These methods, depending on the type of information and the manner in which they are available in map form, may offer faster and/or cheaper ways of digitizing. These methods involve the use of landsat and various scanning techniques.

This Forest has also recently acquired a Global Positioning System (GPS). GPS will offer a means of recording field locations as they are visited (this could be a camping site or a wildlife habitat boundary) and by a computer link

digitize the locations directly into GIS. GPS was to have been used for the transportation layer on this project but because of satellite unavailability it could not be used.

Personnel cost is the second of the five elements discussed by Devine et al. (1986), which might be a significant expense for a specific GIS application. The GIS (including LIDES) hardware and software used on this Forest is complicated in it's features and use. While some tasks were done, with training, all of the use of MOSS and most of the LIDES procedures required the help of experts such as the Forest Data Base Manager, Soil Scientist and contract digitizer. Some of these people can be expensive. If their salary is covered by the project it will constitute a major cost.

The availability of proper field information is another element which represented a cost to this project. Considerable time was spent in verifying the status of the transportation system in the Rim Lakes area. The composite maps may also have benefited from a more thorough field examination of the other layers.

Future Steps

There are several steps which can now be taken to further this project. They are as follows:

- Fuel treatments can be designed and prioritized to eliminate conflicts and increase opportunities for dispersed recreation.
- Using the no-conflict areas shown in Appendix E as a guide, specific sites can be examined to determine suitability.
- Resource criteria used in determining suitability will receive multi-disciplinary review to refine their applicability.

Evaluation

Experience with GIS through this project indicates that the real value of the technology is realized when one or more of the following situations exist: a large number of layers need to be analyzed; a fewer number of layers are required but a large land area is being covered; many alternatives are likely and should be compared; or finally, there is a need to draft or redraft numerous maps. It is, however, not a simple process to apply and can be expensive in time and dollars.

This project fell mostly in the second category. The processing of existing data (soils) and new data (road locations, wildlife conflicts, fuel loading) through GIS is currently providing solutions for the Chevelon District in the management of dispersed recreation. Designation of sites will begin with the next field season and future implementation steps have been identified.

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APPENDIX A

The following is a review of the Forest LMP. Listed are Issues and Concerns; Management Direction; and Standards and Guidelines as they apply to either the Forest in its entirety or the LMP Management Area containing the Rim Lakes Recreation Area.

Public Issues and Management Concerns

- Slash is not being adequately treated in some areas.
- Silvicultural practices to accommodate recreation development is reducing timber growth rates and availability.
- Dispersed recreation in high - use areas is to be managed at a high intensity level.
- More intensive dispersed area management will be implemented along the Mogollon Rim.
- Wildlife species are dependent on riparian areas and this is conflicting with recreation.
- There are conflicts between the number of roads, wildlife and dispersed recreation.
- Violations are being committed by all types of forest users.

Management Direction

- Manage the recreation resource to provide a wide range of dispersed experiences.
- Include visual quality objectives in planning and management activities.
- Establish ORV use areas and closures.
- Maintain habitat to provide for viable populations of wildlife and fish and improve for selected species.
- Timber management activities will be designed to integrate considerations for recreation opportunities.
- Provide for the obliterating of unnecessary roads.
- Projected dispersed recreation output in MRVD's for the first ten year planning period is 714 while projected need for the same period is 891.
- Over the first decade this forest will have over 300,000 acres treated with some type of harvest cut or thinning that will have the potential to influence dispersed recreation opportunities.

Standards and Guidelines (of either Forest - wide or Rim Area application)

- Regulate overnight camping within a 200 foot corridor along the General Crook Trail.
- Manage overnight camping within 1/4 mile of water sources to comply with State Law.

- Avoid placement of roads in meadows and obliterate existings roads presenting conflicts.
- Maintain habitat for viable populations of all existing vertebrate wildlife species.
- Manage habitat capability for each indicator species to 40% of potential. Indicator species for the Rim Lakes Area are:

Yellow - Bellied Sapsucker
Mule Deer
Turkey
Goshawk
Pygmy Nuthatch
Elk
Abert Squirrel
Red Squirrel
Hairy Woodpecker
Spotted Owl

- Implement best management practices to prevent water quality degradation.
- Conserve soil and water resources; avoid permanent impairment of site productivity and ensure conservation of soil and water resources.
- Effectively close or obliterate roads causing intolerable resource damage.

- Permanent roads constructed/reconstructed in critical wildlife habitat must meet specified criteria.
- Seasonally or permanently close existing roads and prohibit off-road vehicle use when conflicts with wildlife and soil objectives occur.
- Emphasize road management in areas where resource/wildlife protection is the dominant Forest policy.
- Manage for the following ROS acreages:

56,954 acres	-- Semi-primitive non-motorized
320,493 acres	-- Semi-primitive motorized
402,595 acres	-- Roaded natural
18,668 acres	-- Rural

Manage for the following visual quality acreages:

294,326 acres	-- Retention
500,826 acres	-- Partial Retention
23,394 acres	-- Modification
17,742 acres	-- Maximum modification

- Maintain structural diversity of vegetation in each 10K unit.
- Permanent road densities should average 3.5 miles or less/square mile.
- Local terminal roads should be closed after each use.

APPENDIX B

Appendix B is a referenced paper by Vern W. Cimmery describing the LIDES system.

LIDES - A Map Digitizing and Processing Package

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ABSTRACT

The Local Interactive Digitizing and Editing System, or LIDES as it is usually called, is a microcomputer based map digitizing and polygon processing computer program. This software package requires a Hewlett-Packard 9020B interactive graphic system. The capabilities of the program allow line, point, and polygon maps to be converted to a digital format. Labels can be attached to map features using an attribute format compatible with the Map Overlay and Statistical System Geographic Information System or using the U.S. Geological Survey standard codes, i.e. major and minor codes. The development of LIDES began in 1981 under the sponsorship of the U.S. Forest Service Geometronics Office in Washington, D.C. LIDES is currently undergoing final modifications based on beta testing at three field offices. At this time, the LIDES package is being used in an operational mode by the Apache-Sitgreaves National Forests in Northern Arizona to accomplish all digitizing and labeling associated with implementation of the MOSS GIS.

HISTORICAL INFORMATION ON LIDES HARDWARE AND SOFTWARE

The U.S. Forest Service became involved in digitizing with the Hewlett Packard 9830 desktop calculators back in the mid-1970's. Because of the need to collect contour and profile digital data from U.S.G.S. quadrangle maps, as well as to calculate the acres of polygons, digitizing software was developed. Many of these early programs were unsophisticated and inefficient. Often, because of poor program design they were error prone.

Digitizing software in the Forest Service became more advanced with the availability of intelligent graphic systems (IGS). The first IGS in the Forest Service used for digitizing was a Tektronix 4051. It was purchased by the Umatilla National Forest in Oregon in 1975. The computer specialist on the Forest designed and programmed digitizing software for use with application programs for designing cable logging sales and in low volume road design. Also, digitizing software was developed for use with maps containing polygons, lines, and points. This latter software was the great-great grandfather of the Local Interactive Digitizing and Editing System or LIDES as it is usually called. Many of the concepts incorporated into LIDES can be traced back to this program.

In 1978 the Six Rivers National Forest in Northern California purchased a Tektronix 4051. The digitizing software from the Umatilla was upgraded and made more sophisticated.

The Siuslaw National Forest in Western Oregon procured a Hewlett Packard (HP) 9845 IGS in 1978. The software from the Six Rivers National Forest was acquired and converted to run on

the HP hardware system. Major modifications were made to incorporate simple data base management and reporting capabilities. This was the last major digitizing package to be developed on an interactive graphic system in the Forest Service until the LIDES project began.

Concurrent with the activities related to digitizing software development in the late 1970's was the overwhelming need expressed by field units, i.e. National Forests, within the Forest Service for resident IGS's. By 1980 out of 126 National Forests in the National Forest System 12 had Hewlett Packard 9845's and three or four had Tektronix 4050 Series systems. The need was taking on a national scope. Consequently, procurement of graphic systems was frozen until a national procurement action could take place. This action was called LOT 7. The exception to this freeze was a system on the Carson National Forest in Northern New Mexico for development of the LIDES software package.

The Carson National Forest was provided a Tektronix 4054 IGS by the Geometronics Development Office in the Forest Service in Washington, D.C. This was in 1981.

The hardware and software background in which LIDES was developed is nearly complete. The national procurement action called LOT 7 was awarded to Tetra Tech, Inc. in San Diego, California in the fall of 1983. The award was for the Hewlett Packard 9020B IGS with a Calcomp digitizing tablet.

The last software relative to LIDES is the line-following or trace software developed at the Forest Service's Geometronics Service Center in Salt Lake City, Utah. This software is in the FORTH programming language and runs on the PDP-11 minicomputer.

LIDES PROJECT DEVELOPMENT

Early in 1980, the Geometronics Development Office in the Forest Service's Washington, D.C. office (WO) drafted a LIDES project development plan. The LOT 7 procurement had not been awarded at this time. However, the intent was to develop a prototype version of LIDES that would be easily adapted to whatever hardware system was awarded. Early in 1981 a project team was formed. In general, the purpose of the project was to:

"... furnish the Forest Service with the software capability to interactively digitize (2 axis), display and edit graphic data. This graphic data may be represented in the form of points, lines, and polygons with associated feature ID's. The final product from LIDES will be a clean digital file of this graphic data in a common format. This digital file can either be transmitted to a larger computer or retained for use by local application software. The design and the documentation of the software will insure capability of implementation on LOT 7 class equipment."

The draft plan specified that the WO Geometronics Development Group, which is responsible for the software effort, will work with personnel on the Carson National Forest in New Mexico in the development, documentation, evaluation, and implementation phases of the LIDES effort. LIDES would be developed on a Tektronix 4054 desk-top system located on the Carson National Forest. This system would be temporary until the contract for the LOT 7 (national procurement effort) hardware had been awarded. At that point, LIDES would be converted to the new hardware by Forest Service Region 3 and the WO. The design and the documentation of the software would insure capability of implementation on LOT 7 class equipment. Most of this effort would be accomplished in-house; however, it was anticipated that some ancillary contractual work might be required. The guidelines, for software development, outlined in Forest Service Manual 6620 and the Automated

Systems Documentation Handbook (Forest Service Handbook 6609.54), would be adhered to throughout the effort by the project team.

The schedule included in the January, 1981 document indicated that program development would be initiated in April and completed by November, 1981. By November, 1981, using the Tektronix 4054 IGS on the Carson National Forest, the first LIDES prototype package was developed. Further development was delayed until 1983 due to personnel attrition in the Washington Office and delays in awarding the LOT 7 contract.

When development started again, in 1984, a new capability was added to the software design. The Geometronics Development office wanted the software to be able to process scanned map data from the Optronics P-1000 drum scanner located at the Forest Service Geometronics Service Center (GSC) located in Salt Lake City. Adding this capability involved two problems: one, equipment was not available at that time to convert and transfer the drum scanner tape output onto an HP compatible medium; and two, the software that would be used to process the scanned data once it was available to the LIDES package was written in the FORTH programming language on a PDP-11 minicomputer. This software was the line-trace software mentioned earlier.

In 1985, the prototype LIDES package consisted of two major parts. The raster part consisted of software for processing the scanned data. This was the line-trace package converted from FORTH to HP 500 BASIC. However, the equipment needed to convert and transfer the drum scanner tape onto an HP compatible medium was still not available. Further development of LIDES depended upon being able to simulate the scanner format. A digitizing module was built, using the Calcomp digitizer tablet, that would collect digitized lines and format the data into simulated scanned data.

The other part of LIDES was the vector part. This was basically the prototype software built on the Carson National Forest and converted to run on the HP. This part also contained the labeling modules. These modules allowed labels to be attached to points, lines, and polygons.

This version of LIDES was intended to allow the processing of scanned data from the GSC and digitized data from the Calcomp digitizing tablet. Once the data had been collected, it would be processed in the same manner regardless of its source. The same processing and labeling modules would be used on both types of data.

The first review of the LIDES software took place in February, 1985. Reviewers strongly recommended that the digitizing mode for simulating scanned data be retained and replace the digitizing approach used in the vector portion. This process was much more efficient than the original method. The only disadvantage was that there was some loss of resolution due to hardware resolution differences between the Optronics P-1000 drum scanner and the Calcomp digitizing tablet. The efficiency gained in automatic polygon construction and semi-automated editing outweighed this consideration.

A test version of LIDES was available in May, 1985. A lot of problems were encountered. Problems that were going to have to wait for resolution. Once again the project was delayed due to attrition in the Washington Office.

A programmer was located on a Ranger District in central Washington State. The WO agreed to fund him through the Forest Service Regional Office in Portland, Oregon, for six months or more until the program was operational. The first relatively problem-free version of LIDES was distributed to testers in April of this year. Update number 7 was distributed on September 12th. Not only have the problems been resolved, but several modifications have been made.

LIDES is being tested in the Regional Office in Portland, on the Siuslaw National Forest in Corvallis, Oregon, and on the Apache-Sitgreaves National Forests in Springerville, Arizona. On the Apache-Sitgreaves National Forests we are actually using the software in an operational mode. We have digitized 8 resource layers of information for 12 quadrangle sheets for the Chevelon Ranger District. We are now in the process of entering these data into MOSS.

DESCRIPTION OF LIDES

The version of LIDES currently being used by field units is update version 7, September 12, 1986. The following output products are available for polygon, point, and line maps:

1. Digitized, edited, and attributed arc/node files.

2. Hardcopy plots at any scale, including map labels.

3. Acreage and perimeter listings by identification number, size, perimeter, attribute, or a combination.

Files can be transmitted to the USDA Fort Collins Computer Center (FCCC) for use by resident programs. Programs available at FCCC will convert the data to USGS Standard or Optional Digital Line Graph (DLG) format. Also, data can be converted to MOSS format or optional DLG format directly by the LIDES program for use by local software such as MOSS.

Hardware/Software Characteristics

LIDES software can be used on any of the interactive graphic systems acquired under the USDA LOT 7 contract. With the exception of a Calcomp digitizing table, all hardware components are manufactured by Hewlett Packard (HP) Corporation. Hardware components include:

1. HP 9020B 32-bit computer with monochrome CRT, ASCII keyboard, 1.5 megabytes of RAM, 5-1/4 inch floppy disc storage, and Series 500 BASIC single user compilers.

2. HP 7908 Winchester Disc Drive with 16.7 megabytes of formatted disc storage and high density cassette tape backup/recovery capability.

3. HP 2932A 136 column impact printer.

4. HP 7580-B plotter which has 8 pens and provides plots on 24 inch wide paper/vellum/double matte polyester film material.

LIDES software is written in the HP series 500 BASIC language reference system.

Digitizing Options

LIDES uses arc/node data collection. This means that all data is captured in the form of line segments, each line segment beginning and ending on a node (a segment intersection). Line segments are stored internally as a string of vectors, each line having right/left polygon identifiers and start/end node identifiers.

Raster processing requires that your map first be digitized and stored on disc as raster data (binary 0's and 1's), where 0's represent background data and 1's represent line data.

Raster data can be acquired via automatic scanning of source manuscripts. LIDES can currently accept scan input from a drum scanner located at the GSC. Scanning is particularly attractive when the need exists to digitize a large number of map sheets that contain large numbers of polygons, e.g. 200 plus per sheet. Scan speed is fast at 5 minutes per map sheet, and spatial accuracy is high.

Given scan data, the most labor intensive user task is the editing of raster data prior to vectorization and assembly. Editing raster data requires adding, deleting and moving pixels, a pixel being a (1) or (0). Software line following algorithms are then employed to automatically vectorize (trace) and assemble (identify line segments belonging to each polygon) polygons. Vectorizing and assembly are relatively fast on the HP 9000 computer at approximately 5 minutes per 100 polygons. This process is faster for line and point maps.

Unlike manual digitizing, where an operator can selectively digitize features, LIDES will vectorize everything on the scanned manuscript. All lines must be solid. There should be no line breaks nor polygon labels. Due to these characteristics, manuscripts may have to be re-drawn prior to submitting them to the scanning process.

LIDES provides tools for finding and correcting line breaks, removing labels and other anomalies. The cleaner your input raster data set is, the less time you will have to spend on your HP system up front during the raster edit phase.

The Calcomp digitizing tablet can be used to gather raster data in lieu of scanning. Data collected in this manner will be lower in quality than scan data and requires labor intensive manual tracing of lines, similar to that involved in any manual digitizing system.

The decision to collect digital map data through the scanning process or through manual digitizing with using a digitizing tablet depends on several factors. The condition of the maps could be significant. Would the maps have to be redrafted? The scanning process converts every line, point, etc. on the map to a binary representation. The more extraneous data that needs to be edited using LIDES the less advantageous is the scanning method. The number of maps being handled is a factor. If a large number of maps need to be digitized, significant time and cost savings can be realized. If only a couple of maps are going to be digitized, it may not be worth the time to prepare them, send them to GSC to be scanned, and process them with LIDES when the tapes are returned when manually digitizing could be used in a fraction of that time. It will be more efficient in time and cost to scan maps that are very complex, i.e. contain a large number of polygons.

The hardware-user interface to LIDES is facilitated by the use of hiearchical menu structures, help screens, and situation prompts. Once the LIDES program is loaded and executed, for example, the first screen display will show the major options available in the program. These are displayed in Figure 1.

- User Guide - printing the user guide and updates.
- Next Step - displays the next step in processing a map.
- File Manager - Creating, storing, copying, and purging files.
- Scan Input - loading of scanned map data.
- Register - registering map corners, entering map scale and state plane zone.
- Digitizer Input - digitizing map points, lines, and polygons.
- Inspect - visual inspection and manual editing.
- HELP - displays the main menu.
- Processing - processing raster data and editing errors.
- Plotting - screen and paper map plots.
- Attribute - assigning and editing attributes.
- Listings - listing map areas and lengths.
- Reformat - output of MOSS and DLG3 files.
- Other Programs - run other programs using LIDES data.
- Load - loads currently selected menu option.
- EXIT - exits LIDES program.

Figure 1. LIDES Main Menu Options.

Each of the commands displayed in Figure 1 is assigned to one of 16 function keys. The 16 function keys are arranged in two rows of 8 keys each. Each function key, when pressed will display a HELP screen which defines the menu selections available in that program module. Pressing the File Manager key, for example, displays a HELP screen containing the information shown in Figure 2 below.

- Maps - displays maps currently on hard disc.
- Status - displays work status of input map.
- List Maps - dumps map list to printer.
- List Status - dumps map status to printer.
- Create - creates a work file for a new map on disc.
- Purge - erases work files for a given map on disc.
- Acquire - retrieves map data files from disc.
- Get/Store - copies map data to or from floppy or tape to disc.
- Backup - instructions for loading DISC_BACKUP utility.
- Notes - prints DISC_BACKUP utility use instructions.
- Edit Mode - displays edit status.
- Next Step - tells the user what the next processing step is for this map.
- Clear Text - clears text display.
- HELP - lists this HELP screen.
- Return - returns to main LIDES menu.

Figure 2. File Manager Menu Options.

If the choices displayed in Figure 2 are the ones the user is looking for, pressing the LOAD function key will load the file manager program into computer memory . At this point, pressing any of the keys will cause immediate execution of that subprogram for the selected option.

All LIDES commands are documented in HELP screens which the user can access.

Normal Processing Sequences

Normal processing begins with turning on the computer. The starting screen display will list the options shown in Figure 1. A typical sequence of steps is illustrated in Figure 4.

Step No.	** Function Keys ** Menu 1	Other Menu	Step Descriptions
1.	(File Mgr)	(Create)	Create a LIDES map file
2.	(Register)		Register map corners
2.1		(Reg Map)	Register map on digitizer
2.2		(Reg Geod.)	Register Lat. & Long.
3.1	(Dig. Inpt)	(Digitize)	Digitize input
3.2		(Completed)	Mark digitizing completed
4.	(Inspect)		Visually inspect map and edit merged lines and breaks.
5.	(Processing)		Edit raster data errors.
5.1			Edit breaks and delete spurs
5.11		(Thin)	Thin raster lines
5.12		(Log spurs)	Locate all spurs and breaks
5.13		(EDIT LOG)	Edit breaks and spurs
5.2		(TYA)	Thin, vectorize, and assemble map
5.31		(Log Sp&Lk)	Locate single island links
5.32		(EDIT LOG)	Edit single island links
5.41		(Log Areas)	Locate polygons <= 30 pixels
5.42		(EDIT LOG)	Edit small polygons
6.		(Inspect)	Visually inspect map and edit all errors found
7.	(Processing)	(TYA)	Thin, vectorize, and assemble map
8.	(Plotting)	(Drum Plot)	Plot map
9.	(Attribute)	(Att. Dig.)	Enter polygon attributes using the digitizer
10.	(Reformat)	(Begin)	Output a MOSS formatted file

Figure 4. Typical Sequence of Processing Steps for a Polygon Map.

The above figure describes normal processing for polygon maps. The process for line and point maps is similar.

SUMMARY

The LIDES software package is a very powerful program. It has the flexibility to support any existing GIS used by the Forest Service during the next three years. Depending on how the national GIS workload analysis goes, LIDES may be used much longer than the next three years by National Forests having the HP interactive graphic system. It has taken five years for LIDES to become operational. It is a very well-designed, efficient package.

ACKNOWLEDGEMENTS

Many people within the Forest Service and some no longer with the Forest Service need to be mentioned and acknowledged for their support and participation in the LIDES project. These are Terry Gossard, Chief of the Forest Service Geometronics Office for his continued support of the project; Roger Peletier, the original team leader; Tom Bruce of the Carson National Forest (previously on the Umatilla and Six Rivers National Forests) without whom LIDES would not be in existence (and the Forest Service would probably not have received IGS when we did); programmers Dick Liston, Yance Revanaugh, and Bob Mahoney; Holly Martin in Geometronics in Region 6 who has guided the pilot testing phase; and last, the programmer who took the "crude" version of LIDES and turned it into a pleasurable tool to use, John Dabritz of the Okanogan National Forest in Washington. This paper is, I hope, a just tribute to the efforts of these people.

APPENDIX C

Appendix C contains the following layers:

Soils; This map shows all the TES types which occur within the Rim Lakes Recreation Area. This includes symbols 196, 197, 199, 201, 203, 206, 207 and 208.

User Zones; This is as described in the text. The green area relates to the area where dispersed camping at designated sites will be permitted.

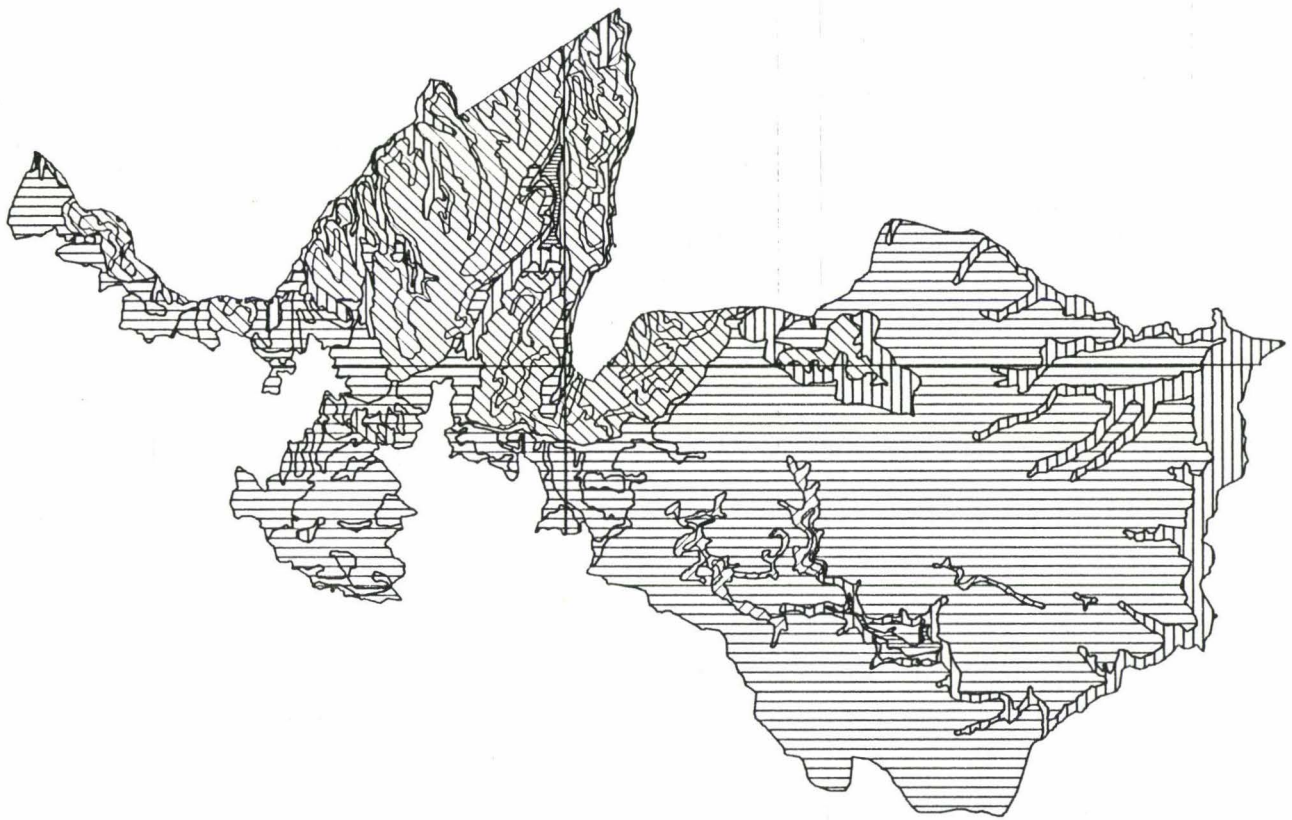
Wildlife Areas; The red areas on this map indicate potential wildlife conflict areas.

Roads; This map shows roads which are open to use within the area available for dispersed camping. There are many additional roads which have been closed but are not shown.

ROS; This map shows the ROS classes as they appear in the Forest LMP. The green area was the preferred class for dispersed camping.

Fuels; This map shows the various fuel loading within the Rim Area. The blue, green and black(40) was the preferred loading.

PLOT OF ALL SOILS IN RIM PLAN



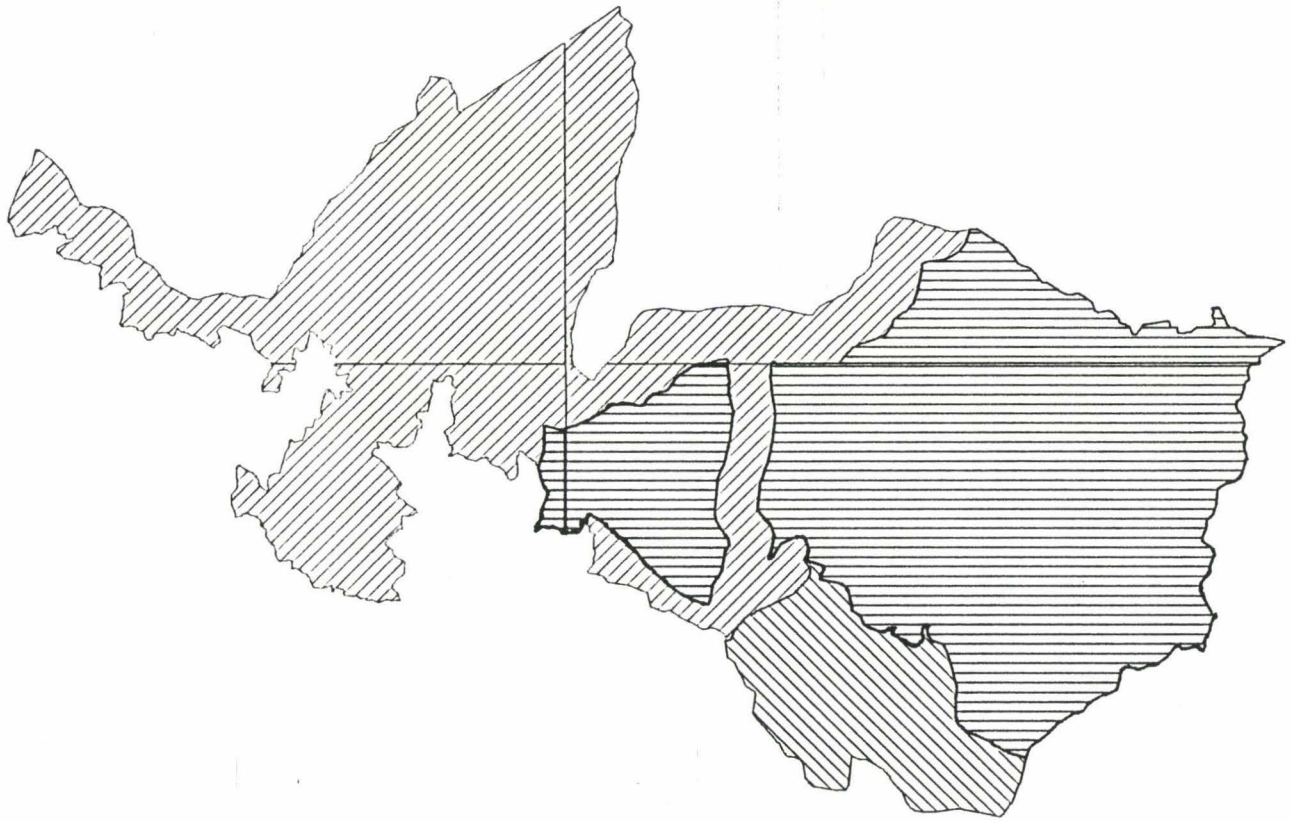
SCALE 1: 120000.

AUTOGIS

MAP LEGEND

- TES MAP SYMBOL 196
- TES MAP SYMBOL 197
- TES MAP SYMBOL 199
- TES MAP SYMBOL 201
- TES MAP SYMBOL 203
- TES MAP SYMBOL 206
- TES MAP SYMBOL 207
- TES MAP SYMBOL 208
- WATER

RIM PLAN USER ZONES



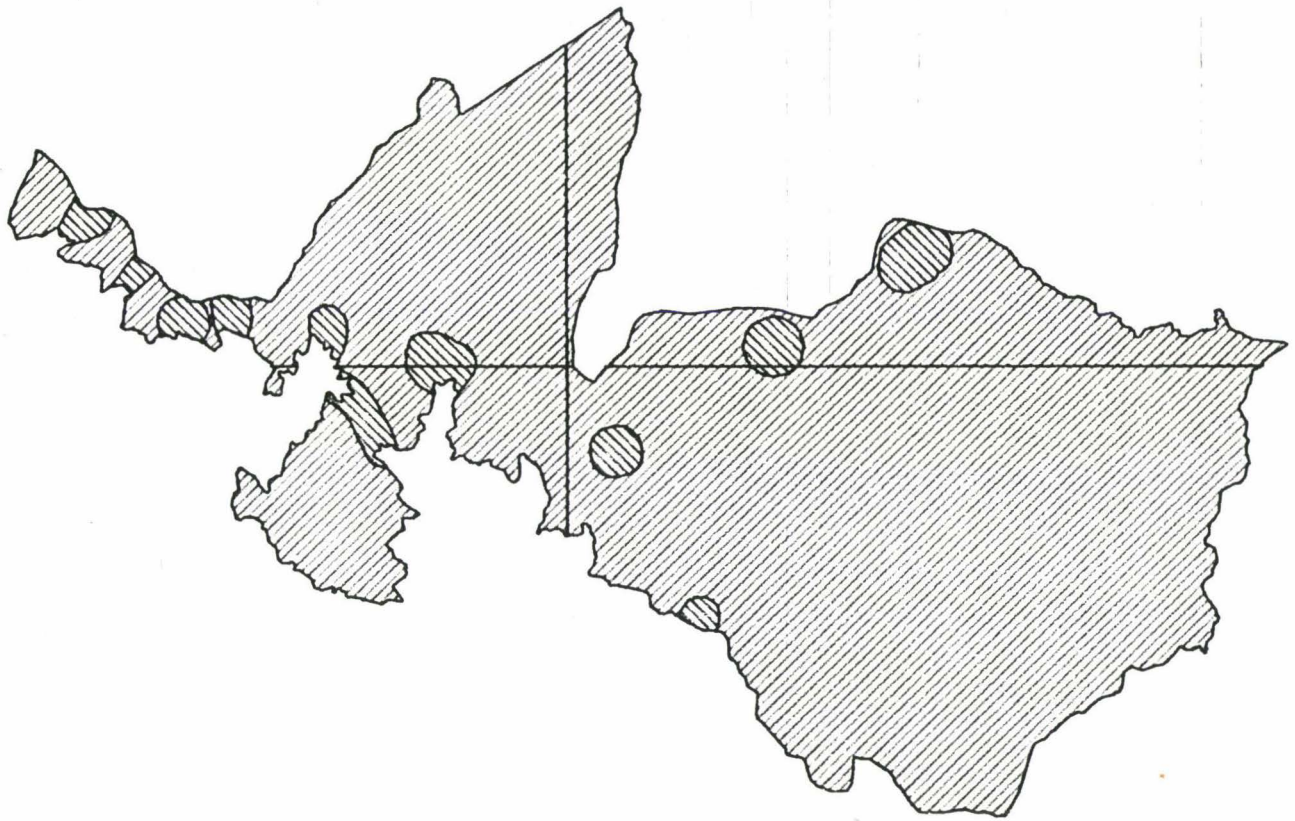
SCALE 1: 120000.

AUTOGIS

MAP LEGEND

NO VEHICLES

RIM PLAN POTENTIAL RECREATION/WILDLIFE CONFLICT AREAS



SCALE 1: 120000.

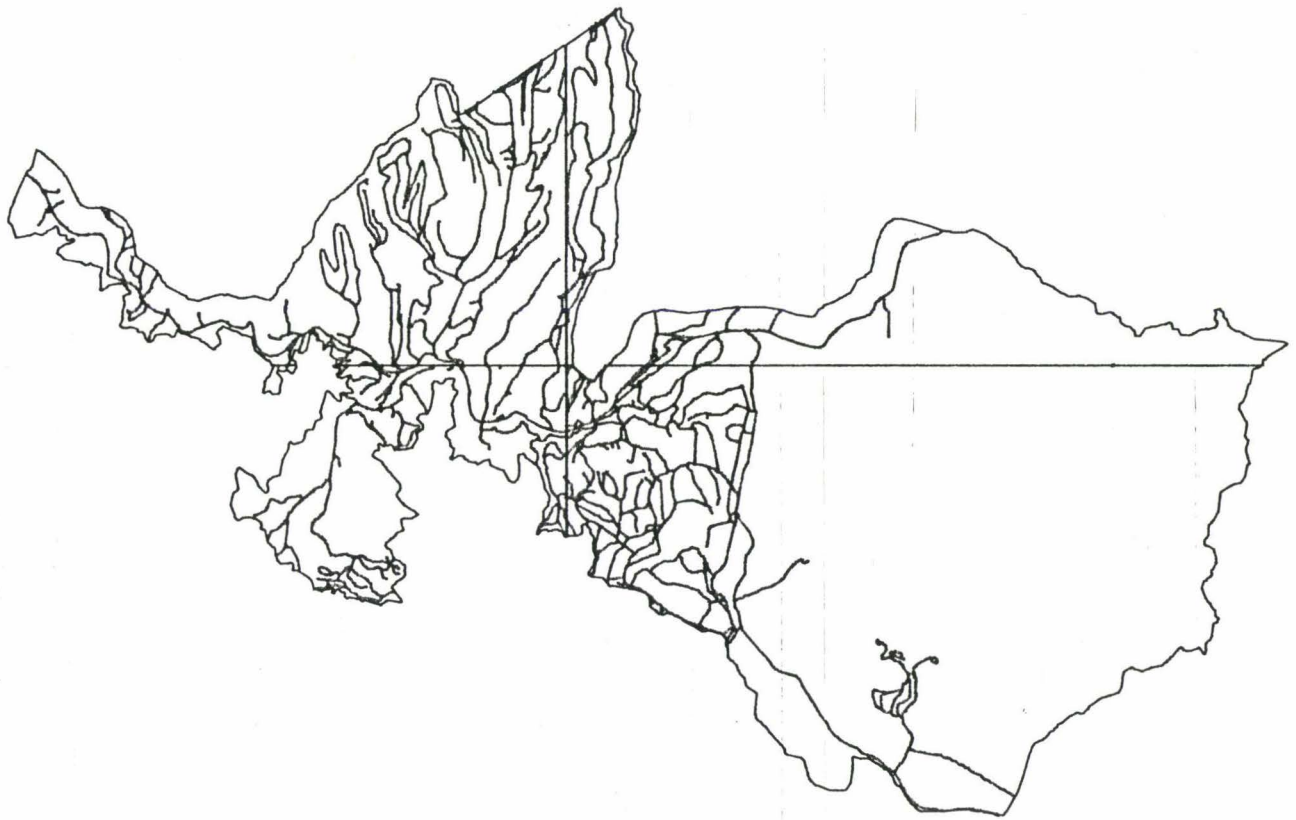
AUTOGIS

MAP LEGEND

POTENTIAL WILDLIFE CONFLICT

WILDLIFE NO CONFLICT

RIM PLAN OPEN ROADS



SCALE 1: 120000.

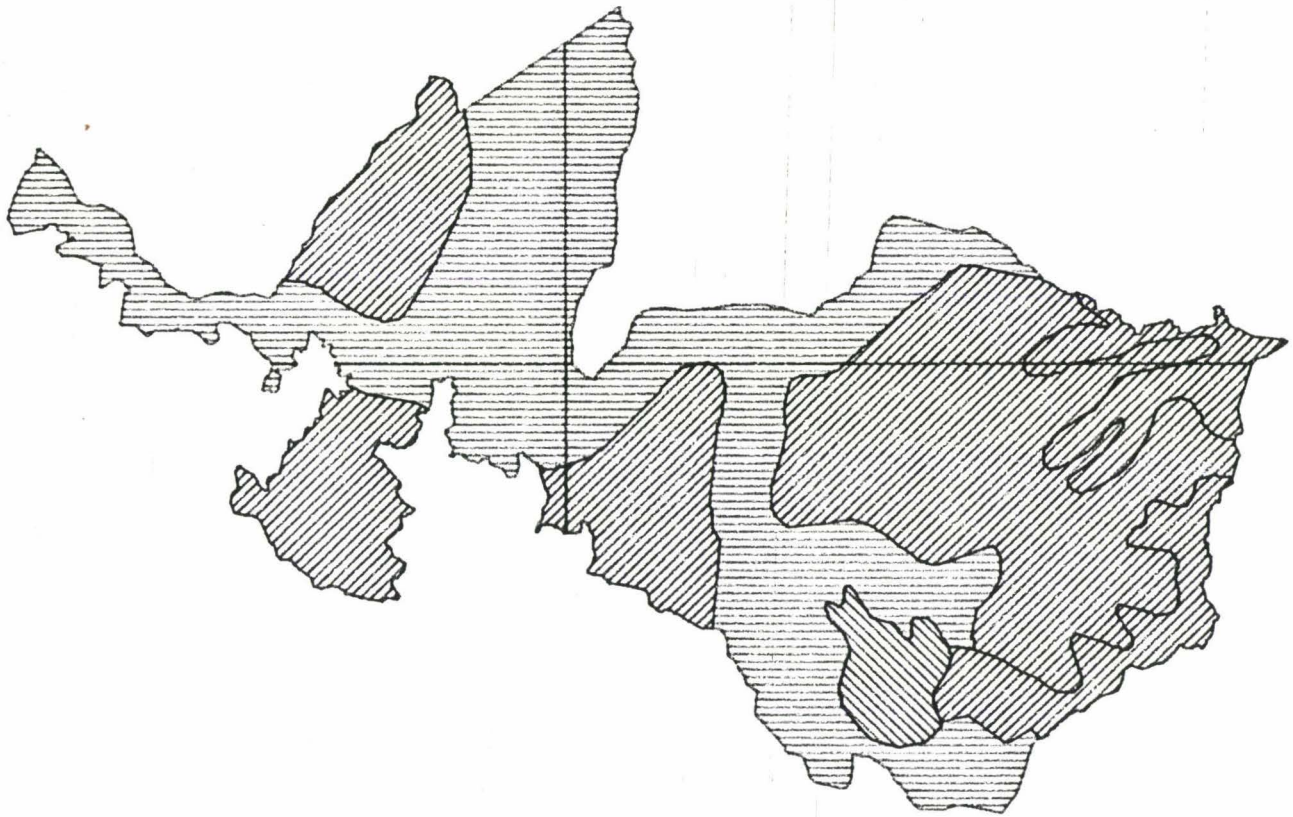
AUTOGIS

MAP LEGEND

RIM PLAN BOUNDARY

OPEN ROADS

RIM PLAN RECREATION OPPORTUNITY SPECTRUM CLASSES



SCALE 1: 120000.

AUTOGIS

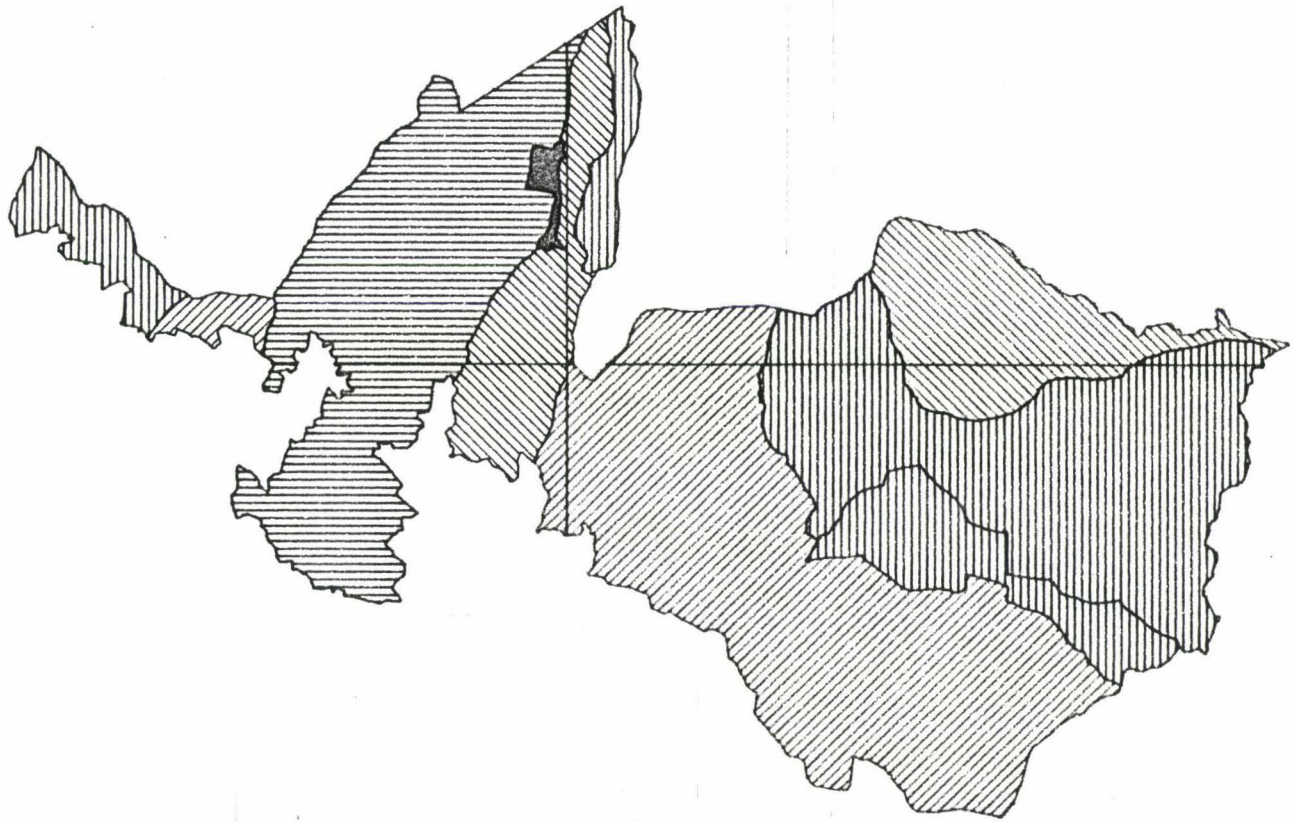
MAP LEGEND

ROADED NATURAL

SEMI PRIMITIVE MOTORIZED

RURAL

RIM PLAN FUEL LOADINGS IN TONS/ACRE



SCALE 1: 120000.

N

AUTOGIS

MAP LEGEND

- FUELS 0
- FUELS 10-15
- FUELS 15-25
- FUELS 25-35
- FUELS 40
- FUELS 40-50
- FUELS 50-60
- FUELS 60-80

APPENDIX D

This map is Alternative A which shows a green shaded area with the following characteristics:

-The area has only the TES types 196, 197, 201, and 207.

-Vehicles are permitted on designated routes.

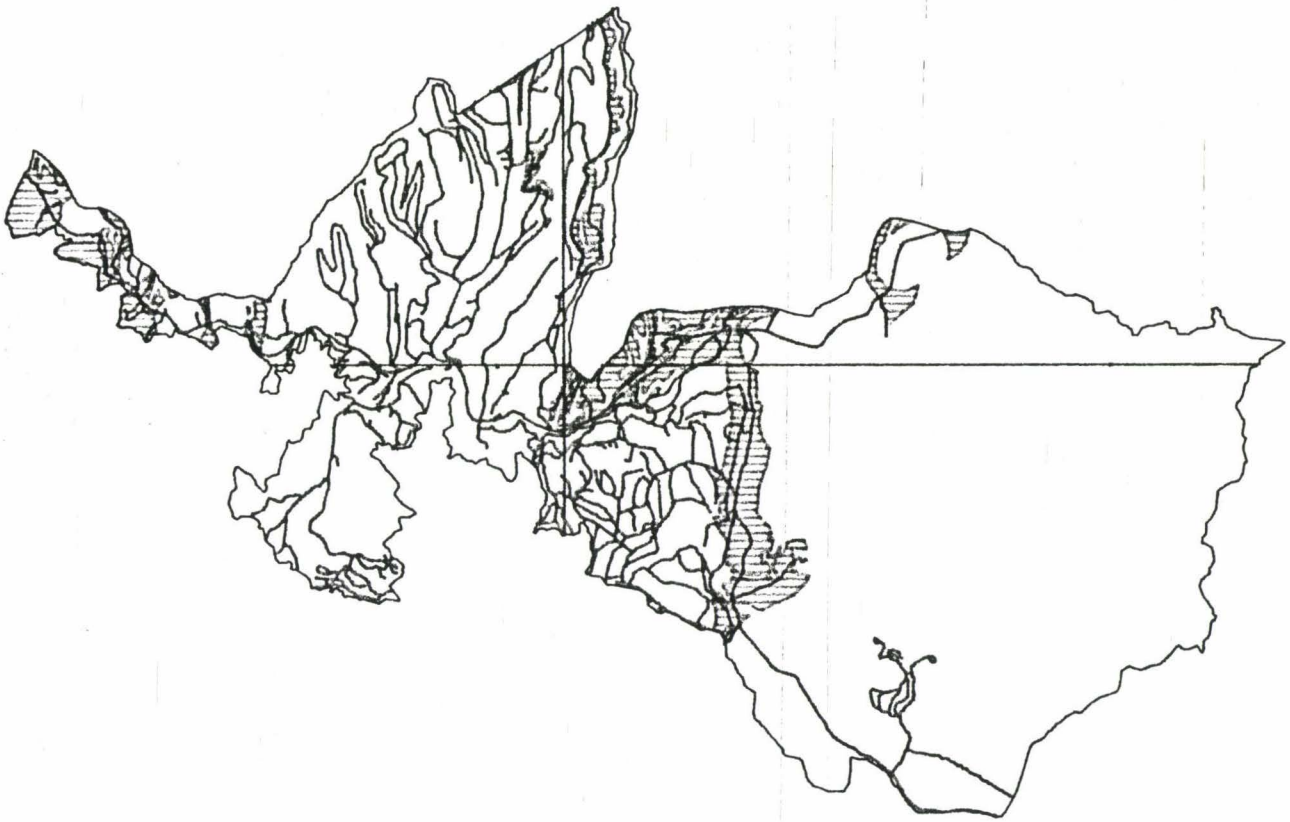
-Areas where there are no wildlife conflicts.

-ROS class roaded natural is the only class shown.

-The fuel loading is 40 tons/acre or less.

-On top of the above information is over-layed the open road system.

RIM PLAN AREA ANALYSIS – ALT A



SCALE 1: 120000.

AUTOGIS

[illegible] THE RIM PLAN MAKES THE "POSSIBLE OR" MORE [illegible] AND SOIL TYPES 106,107,202,207 AND [illegible] OF 60 TONS/ACRE OR LESS AND THE "BORDER RETURN" ARE CLOSE [illegible], WITH NO POTENTIAL WILDLIFE CONFLICTS.

MAP LEGEND

SEE DESCRIPTION ABOVE

RIM PLAN BOUNDARY

OPEN ROADS

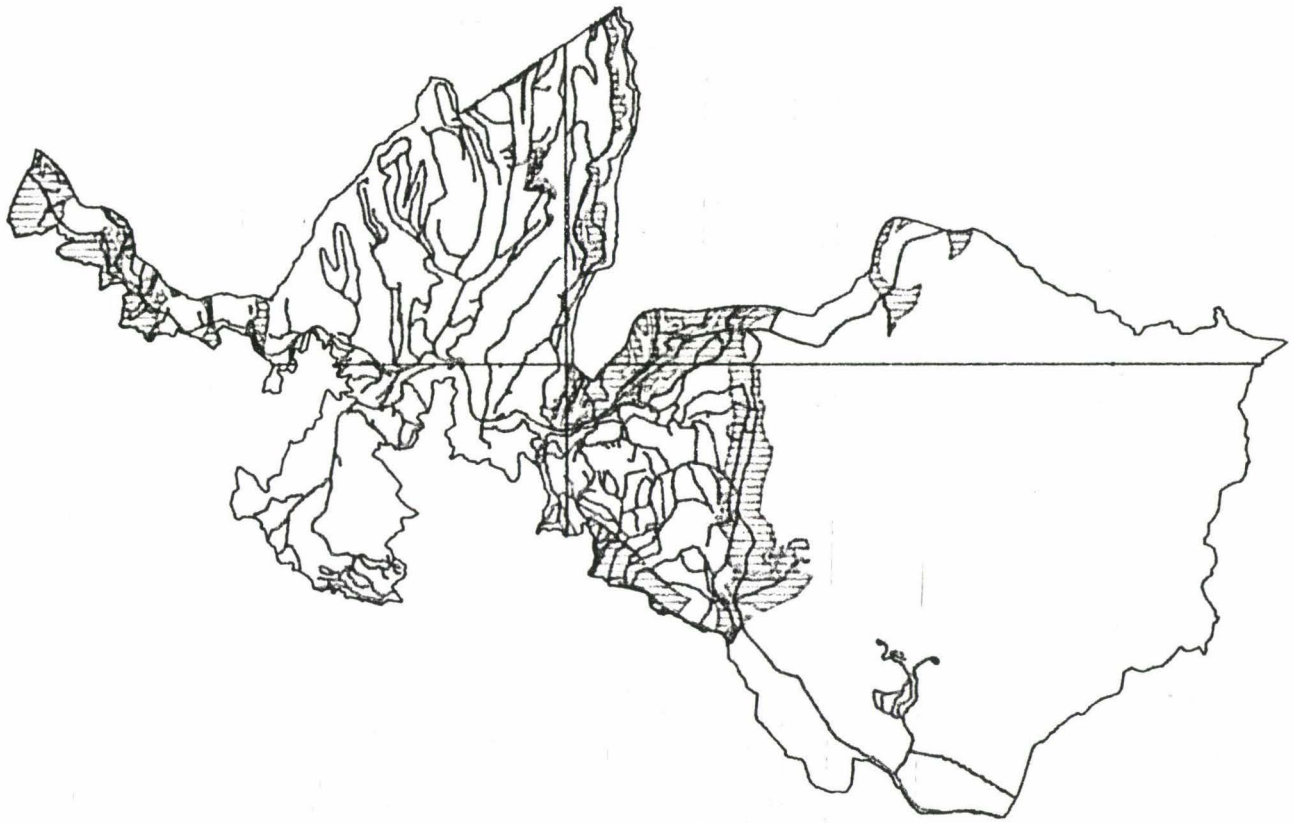
APPENDIX E

This is the selected alternative and it shows a green shaded area with the following characteristics:

- The area has only the TES types 196, 197, 201 and 207.
- Vehicles are permitted on designated routes.
- Areas where there are no wildlife conflicts.
- The fuel loading is 40 tons/acre or less.
- The road system has been over-layed on the above information.

This map includes an area along the rim which is classified as semi-primitive motorized but which should be used for dispersed camping.

RIM PLAN AREA ANALYSIS – ALT B



SCALE 1: 120000.

AUTOGIS

[illegible]

MAP LEGEND

SEE DESCRIPTION ABOVE

RIM PLAN BOUNDARY

OPEN ROADS

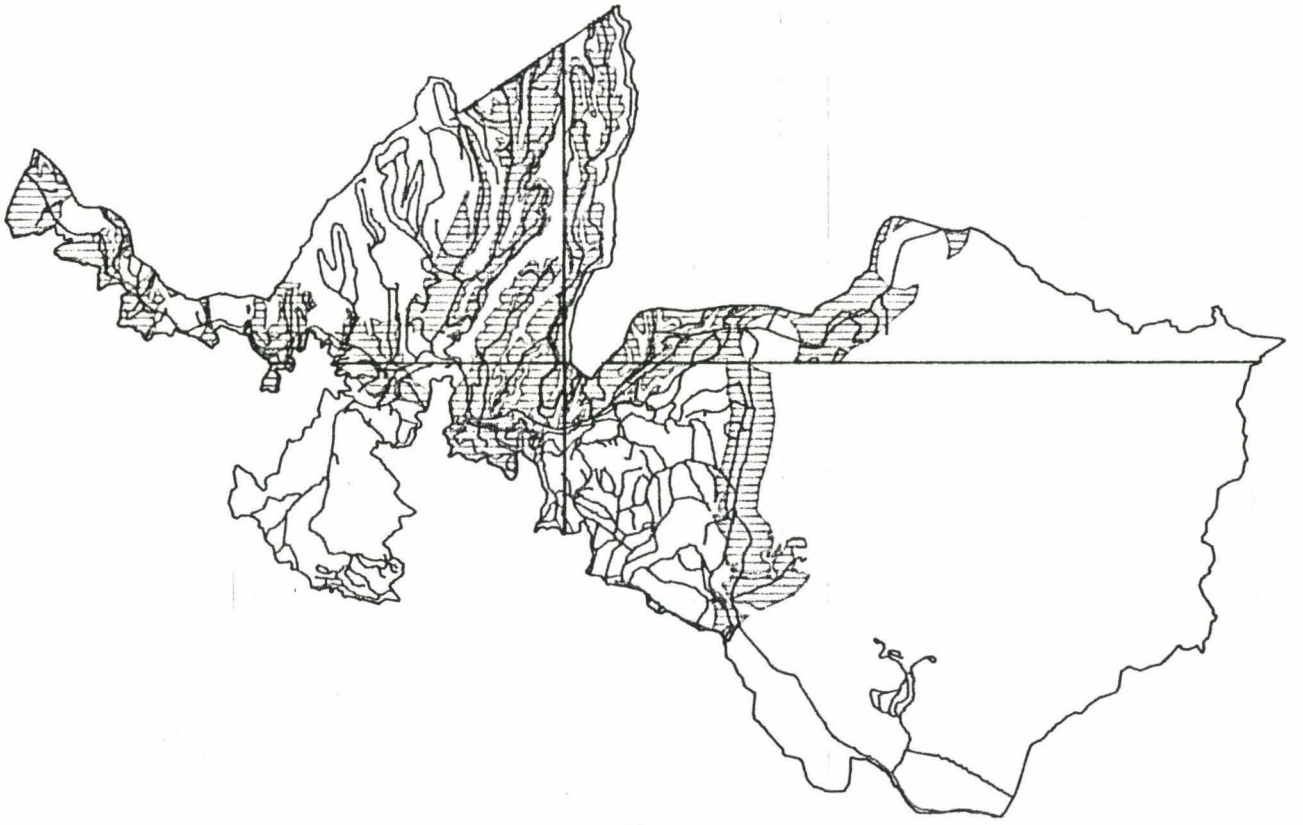
APPENDIX F

This map shows Alternative C which has a green shaded area with the following characteristics:

- The area has only the TES types 196, 197, 201 and 207.
- Vehicles are permitted on designated routes.
- Areas where there are no wildlife conflicts.
- ROS class roaded natural is the only class shown.
- The road system has been over-layed on the above information.

This map shows areas, which with future fuel treatment, could be considered for dispersed camping.

RIM PLAN AREA ANALYSIS – ALT C



SCALE 1: 120000.

1
#

AUTOGIS

[illegible]

MAP LEGEND

SEE DESCRIPTION ABOVE

RIM PLAN BOUNDARY

OPEN ROADS